paper. "Even though there are lacunae in the evidence, the patterning of almost all the recent studies, ours as well as others, points the total picture overwhelmingly in one direction. The geneticists will need to give more than *post hoc* data and will require experimental or better controlled epidemiological studies than have previously been offered to support their views. Otherwise, scientific parsimony seems to lead one to the conclusion that at the present time the most useful theory is that while man's fundamental structure and consequently his basic functioning is genetically determined, it is his socio-cultural milieu affecting biological and psychological variables which modifies his behavior and, in the absence of organic brain damage, makes one individual significantly different from the next" [(*1*), p. 263].

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Calcite in Lesquerella ovalifolia Trichomes

Abstract. By chemical analysis, trichomes of *Lesquerella ovalifolia* Rydb. have been shown to contain a high percentage of calcium carbonate. X-ray diffraction patterns showed that it was in the form of calcite. The calcite was inside the trichomes, and its depositional pattern conformed to the shape of the trichomes. A small amount of opal was present in the trichomes.

Recently a photograph of trichomes of *Lesquerella ovalifolia* Rydb. appeared on the cover of *Science* (*1*); they were reported to be highly refractive. The present investigation was begun to see whether or not the refractivity might be due to the presence of silica.

The plants used in these experiments grew in Scott County, Kansas, on steep rocky slopes with limestone outcroppings. The trichomes were scraped from the leaves with a razor blade and dried in an oven at 110°C. Part of the trichomes were ashed at 500° to 600° and silica was determined by standard gravimetric techniques. The silicon dioxide content was determined by difference of weights before and after treatment with hydrofluoric acid.

Fig. 1. Spodogram showing calcite depostion in *Lesquerella ovalifolia* Rydb. trichomes (about × 53).

Calcium was determined on another ashed sample by the standard A.O.A.C. method with a Beckman model DU flame spectrophotometer and a Sargent recorder. Carbon dioxide was determined by using the standard gas-evolution method directly on oven-dried, powdered trichomes. X-ray diffraction patterns were made for both powdered trichomes and the ash of trichomes on a North American Phillips diffractometer with nickel-filtered copper radiation obtained with a current setting of 20 ma at 40 kv.

Petrographic microscope studies were made on the silica obtained by ashing trichomes and treating the ash with hydrochloric acid. Trichomes were also examined directly with the petrographic microscope.

The depositional pattern of the carbonate was determined by making a spodogram. The spodogram process was developed by Uber (*2*), modified by Ponnaiya (*3*), and used by Lanning *et al.* (*4*) for determining silica depositional patterns in plants.

The results showed that the trichomes made up 51.7 percent of the leaves and that the trichomes were 30.8 percent ash. Chemical analysis showed that the trichomes contain 0.492 percent silicon dioxide, 10.8 percent calcium, and 12.23 percent carbon dioxide. Petrographic microscope examination of the silica showed it to be part plant opal and part detrital quartz. The calcium and carbon dioxide values indicated that the trichomes were 27.0 percent calcium carbonate and that the ash was 87.7 percent calcium carbonate. Trichomes of plants from Sheridan County State Park in Kansas contained 11.1 percent calcium.

High values for plants from two different areas indicate that high deposition of calcium carbonate in the trichomes is a characteristic of the species. The values also indicate an exceptional differential accumulation of calcium, for the leaves without trichomes contained only 2.25 percent calcium. The latter value is about average for leaves of many of the Cruciferae (*5*).

Calcium compounds are commonly deposited in phloem tissue and veins of plants (*6*), often in the form of the oxalate, pectate, or carbonate. In 1932 hackberry seed was reported to contain a very high percentage of calcium (*7*). In 1959 Swineford and Franks (*8*) found hackberry seed to contain 45.51 percent calcium carbonate in the form of aragonite.

The x-ray diffraction pattern of the ash showed the sharp peaks characteristic of calcite (*9*). No other sharp peaks were observed, indicating that the ash was largely calcium carbonate in the form of calcite. The x-ray diffraction pattern of the powdered trichomes also showed the calcite peaks. In addition it showed x-ray peaks of cellulose and small quartz peaks (detrital).

A spodogram of the trichomes (Fig. 1) shows that the depositional pattern of calcite is just like that of the trichomes. Microscopic examination showed that the calcium carbonate was inside the trichome and surrounded by organic matter of the cell wall. Some plant opal was also observed (*10*).

As far as I am aware, this is a first report of calcite in *Lesquerella ovalifolia* and in the genus. It also appears to be a first report of high calcium carbonate deposition in trichomes.

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References and Notes

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